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(54) **Apparatus for treating slaughtered animals.**

(57) Apparatus for injection of treatment solution into slaughtered animals which includes a container (12) for holding a quantity of treatment solution, means (16) for establishing flow of solution from the container source, automatic valve means (22) for receiving the flow of solution, header means (32) for receiving solution flow from the container valve, conduit means (36, 38) joining the header means to container (12) for recirculating solution thereto, pressure sensing means (30) positioned proximate the joining area of the header means (32) and conduit means (36, 38) thereat for sensing pressure, and at least one dispensing conduit means (60) connected to the header means (32) for accepting solution therefrom at controlled pressure and injecting it into a slaughtered animal.

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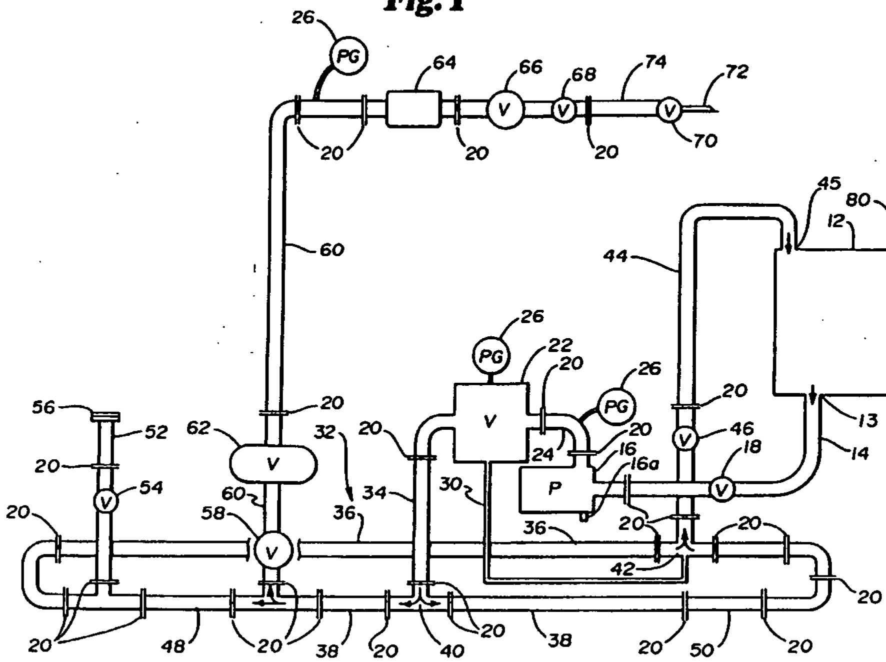
Fig. 1


26
PG
64
66
V
68
V
74
72
V
70
20
20
20
45
80
12
60
44
26
PG
22
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PG
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46
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16
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13
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16a
P
54
V
34
30
60
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Background

The subject invention is related to and is an improvement over U.S. Patent 4,053,963 and the various prior art cited therein, all of which is incorporated herein by reference. Generally, that prior art relates to meat treatment by injection of various liquid compositions and to apparatus for accomplishing same.

Summary of the Invention

The subject invention is specifically concerned with improved apparatus for use in the treatment of slaughtered animals by injecting treatment solution into the animal's circulatory system. The apparatus is useful in the treatment of beef, horses, hogs, poultry, deer, buffalo and the like. The apparatus may be portable or permanently located.

It is to be understood that this invention is capable of using any of a variety of treatment solutions described in the prior art, especially aqueous solutions such as those referred to in U.S. Patent 4,053,963 and its co-pending application (now abandoned) Serial No. 645,309 filed December 29, 1975, entitled "Composition and Method for Preparing Meat," and to later improved versions of such solutions. Examples are solutions of water and one or more of the following: maltose and dextrose, ascorbic acid, sodium tripolyphosphate, hydrolyzed milk protein, papain or bromelin or ficin, potassium sorbate, tetrasodium pyrophosphate and sodium citrate. Additionally, water soluble polysacchride gum and/or calcium chloride, sodium chloride and potassium chloride may be included.

The procedure for using the apparatus of the invention begins with the stunning of a steer, for example, following which it is hung by its hind leg or hind legs, usually on an overhead conveyor or the like. Typically, the jugular vein is then opened at the neck to bleed the animal. Otherwise, in other techniques, the incision is made in the heart. The animal may then be laid on a work surface with its legs extending upwardly or it may be kept hanging. Referably, all four leg vessels are severed, or all four legs are severed at the knee joints. An injector nozzle with a self-piercing tip is then inserted into the jugular at a location proximate to the earlier incision therein but closer to the heart. The injector nozzle, being attached to a dispensing conduit of the apparatus, allows treatment solution to be pumped from the apparatus, through the nozzle and into the animal's circulatory system. The solution, after forcing out residual blood, eventually exits from the severed leg vessels and from the first incision in the jugular vein.

It is critical that the injection solution be delivered into the animal's cardiovascular system at a consistent pressure which is not so low as to lead to incomplete distribution throughout the animal or so high as to rupture vessels. The improved apparatus of this invention provides in its most preferred embodiment for such consistent, controlled pressure. The improved apparatus in its most preferred embodiment is also computer controlled as to flow rate, dosage of treatment solution and data tabulations. It also provides for multi-line dispensing conduits or work stations.

An important feature of the apparatus comprises the use of an automatic control valve with a control system for control of downstream pressure to a steady value. This is accomplished by locating the downstream pressure sensor of the value's control system in a critical location, to be described more fully, below, which provides substantially constant pressure values in single or multiple dispensing lines.

The apparatus also provides for cooling of the treatment solution. This "rapid chills" the animal and enhances the butchering and deboning of the carcass.

These and other features of the invention will become apparent from the detailed description provided below.

Brief Description of the Drawings

Figure 1 is a schematic showing of the solution handling apparatus of the invention with direction of flow indicated by the arrows;

Figure 2 is a detailed view of the self-piercing injection nozzle of the invention;

Figure 3 is a block diagram of the component parts of the apparatus;

Figure 4 is a block diagram of the component parts of the microcomputer;

Figure 5 is an embodiment of the program's Main menu displayed on a CRT;

Figure 6 is an embodiment of of the Administrative menu password screen;

Figure 7 is an embodiment of the Administration menu displayed on a CRT;

Figure 8 is an embodiment of the Change Password menu displayed on a CRT;

Figure 9 is an embodiment of the Change System Information menu displayed on a CRT;

Figure 10 is an embodiment of the process control menu password screen;

Figure 11 is an embodiment of the process control menu;

Figure 12 is an embodiment of the four Valve Operation Control screens simultaneously displayed on a CRT;

Figure 13 is a flow chart of the steps included in selecting a valve to control and entering information;

Figure 14 is a schematic diagram showing three memory locations set aside as counters for each valve;

Figure 15 is a schematic diagram showing memory locations set aside for various flags depicting the status of each valve;

Figure 16 is a flow chart showing the steps executed by the Interrupt program;

Figure 17 is a flow chart showing the steps executed by the Pause program;

Figure 18 is an organizational diagram for a schematic circuit diagram made up of multiple Figures 18a - 18e and is a circuit diagram showing an embodiment of the electronic control means of Figure 3.

Description of the Preferred Embodiments

The apparatus of the invention is comprised of a computer control section and a solution handling section. The solution handling section includes a storage container or tank, pump, valves, hoses, pressure meters, nozzles and interconnecting conduits and the like. Stainless steel tankage, pipes, fittings, couplings, adaptors, bushings and clamps along with vinyl food handling tubing and hoses are primarily used in constructing the solution handling equipment to render it sanitary and easy to clean. Such fittings and the like are commercially available. For example, stainless steel fittings, ties, clamps, bushings and adaptors are available in a variety of sizes and configurations as needed from L.C. Thomsen & Sons, Inc. of Kenosha, Wisconsin, PVC transfer hose, sometimes referred to as "milk hose" is available from Kuriyama of America, Inc., Elk Grove village, IL 60007 and is identified by them as Tigerflex Milk Hose. Vinyl food handling tubing is readily available from Mayon Plastics of Hopkins, MN 55343 identified by them as Mayon Food Tubing, Grade R206-1.

Referring to Figure 1, the solution handling section of the apparatus is shown in schematic for simplicity of understanding. It includes a stainless steel storage container means or tank 12 for holding treatment solution. Tank 12 may be of varying size and shape. A preferred tank is one of about 170 gallon volume, 16 gauge about 97cm x 89cm x 137cm (38 inches x 35 inches and 54 inches) having a piano-hinged top (not shown) as provided by Process Equipment Corporation of Belding, MI 48809. Attached to the outlet 13 of the tank is a first conduit means, preferably in the form of a 1-1/2 inch conduit arrangement 14 and which may include stainless steel elbows and vinyl food handling tubing as necessary, for carrying treatment solution from tank 12 to a pump 16 or other suitable means for creating a flow of solution in the apparatus. A manual valve 18 may be included in this section of the conduit line. It may, for example be a Cooper Manufacturing ball valve Model #4151 SE 316 3-PC. A Thomsen clamp 20 may be used to attach conduit 14 to pump 16. A typical clamp for this purpose is a T-13, double screw, wing nut clamp which includes a silicon or Teflon gasket. Such clamps may be used throughout the apparatus as indicated by legend 20 throughout. In order to make use of standard arts, conduit 14 may be reduced in diameter from 38,1mm to 31,8mm (1-1/2 inches to 1-1/4 inches at some point between coupling 20 and valve 18 to adapt conduit size to standard intake line size of the pump. Pump 16 in turn conducts treatment solution to automatic valve 22 via a second conduit means in the form of a conduit line 24 which is 1 inch in diameter as is the remaining conduit line associated with the apparatus up to the injection nozzle. Again, this reduction in size is to accommodate standard parts, the pump output being 1 inch in diameter. Pump 16 is preferably an electrically operated pump, more preferably of the centrifugal type such as the FST-3000, Model 35 Stainless Steel Centrifugal Pump (close coupled) as provided by the Bell & Gossett Fluid Handling Division of ITT Corporation. A pressure gauge 26 may be included in line 24 for monitoring purposes. This valve may typically be of the stainless steel pressure valve type #WI 233.50 provided by WIKA of Hauppauge, New York with a 2-1/2 inch dial.

Automatic control valve 22 is of the type which is designed to control downstream pressure to a steady value regardless of changing flow rate and/or varying inlet pressure. One such valve capable of accomplishing this is the type available from the Cla-Val Co. of Newport Beach, CA, as Model 90-01 Series (90G-01 ABSKG). It is a pressure reducing valve which consists of a main valve and a pilot control system including a pressure reducing valve (not shown) (model CRD) and a pressure sensing line or feedback conduit 30.

The location of the open end of pressure sensing line 30 is critical to the operation of the apparatus. For proper control functioning of valve 22, the end of line 30 can only be located at the "T" intersection where recirculation line 44 meets header line 36, as shown is an example of such an arrangment.

When the end of line 30 is located elsewhere problems occur. With only one line operating in a multiline apparatus, extreme cavitation of valve 22 and extreme pressure fluctuations occur. In subsequent use, additional lines have been found to exhibit erratic pressure fluctuations as well. Also, the response time of valve 28 increases to unacceptable levels in excess of 5 seconds.

The ultimate result of such malfunctions is that definite variations occur in the amounts of solution

injected through the lines and into animals.

Treatment solution is conducted from pump 16 through valve 22 to a header means generally indicated at 32 via a third conduit means in the form of conduit line 34. Header 32 is preferably comprised of paired conduit means 36 and 38, preferably, having a common inlet 40 and having a common outlet 42, between which the flow of treatment solution exiting from conduit 34 branches into two directions in header 32 to meet at common outlet 42. One branch or more than two branches may also be used. The flow of treatment solution meeting at common outlet 42 recirculates to storage container 12 via fourth conduit means in the form of a recirculation or conduit line 44 extending to the inlet 45 of container 12. Line 44 may contain a manual valve 46 which may be a Worcester ball valve product #WOC 5866R-SE. Manual valves 18 and 46 are placed in lines 14 and 44, respectively to accommodate replacement of tank 12. In operation, multiple tanks will be used. When one tank empties, valves 18 and 46 are closed and the apparatus is disconnected and reconnected to a fresh tank. The valves are opened and processing is continued. The empty tank may then be recharged with treatment solution for subsequent use.

As indicated above and in accordance with this invention it has been discovered that locating pressure sensor 30 for automatic valve 22 proximate the common outlet 42 of header 32, where the branched flow of solution meets, enables the valve to maintain the pressure in the header means and in all dispensing conduit means attached thereto, such as the means generally designated 60, at a steady value whether there is only one dispensing conduit or a plurality of them in use and attached to header means. Preferably, additional dispensing conduit lines (not shown) will be included as at 48 and 50. Most preferably, four such lines will be included in the apparatus although only one is shown for simplicity of description. Also, a drain line 52 with valve 54 and cap 56 may be included in header means 32. A drain 16a (normally closed) may also be included in the bottom of pump 16.

Referring now to dispensing conduit means 60, of which only one is shown, it is connected into header means 32 (36). Flow into conduit means 60 may be controlled by means of a valve 58 which is preferably of the same type as valve 54 in drain line 52, i.e., a manual butterfly valve. Conduit line 60 also includes a normally closed electrically operated valve 62 which is computer controlled as described further hereinbelow. Valve 62 may for example be a stainless steel electric ball valve of the type manufactured by Jamesbury of Worcester MA, Model A, Type 1"21-3600TT3 which is solenoid operated. Conduit means 60 may also include a pressure valve 26, a flow meter 64, a manual valve 66, a check valve 68 and a manual ball valve 70 to which an injection nozzle 72 is connected (best seen in detail in Figure 2). In practice, valve 66 is initially adjusted to a predetermined flow rate which is read on flowmeter 64 at which time the overall system is considered adjusted. Valve 66 is then left set more or less permanently. Flow meter 64 may be of the turbine type supplied by Halliburton Services, Special Products Division, Duncan Oklahoma as part #458.8001. Valve 66 may be of the same type described at 46 hereinabove in line 44. Valve 70 may be of the stainless steel ball type manufactured by Crane Ordway Corporatiron under the trademark CAPRI and identified as part #2000 CWP CF 8M. The section 74 of dispensing conduit means 46 will preferably consist of a convenient length of vinyl food handling tubing such as that available from Mayon Plastics of Hopkins, Minnesota 55343. A clamp arrangement (not shown) may be attached to the nozzle or upstream of it to hold the nozzle in position in the animal and force the operator for other duties. Any suitable clamp eg., an allegator clamp or the like, may be used for this purpose.

Referring now to Figure 2, a detailed showing of the hollow injection nozzle 72 is provided. It includes a self-piercing tip 90 and is threaded at 92 to be fitted into valve 70. Nozzle 72 functions as a conduit for the treatment solution.

The apparatus will also preferably include a solution cooling arrangement such as means 80 in container 12 for cooling the solution therein. The arrangement shown in Figure 1 is schematic and 80 is intended to indicate a cooling coil and associated operational means such as condenser and refrigerant, as are well known. Any arrangement may be used. One such arrangement may include (not shown) a copper coil wrapped around tank 12 on the outside and bottom with insulation covering the coil similar to the hot water heater jacket used for energy conservation. A condenser may be connected to the coil and the system then charged with a refrigerant such as R-22. Such an arrangement will adequately cool the treatment solution.

Preferably, the apparatus is normally operated by two people. One person handles the injection nozzle which has been pre-set as described above with all valves "open" except for electrical valve 62. This person inserts the nozzle into the animal and signals a second person at the computer who is responsible for entering data appropriate to the animal to be treated. This is described more fully hereinbelow. Upon being signaled, the computer operator presses a "start" button and the computer controls the injection treatment by program as will now be described.

Referring now to the computer control section of the apparatus, reference should be made to

Figure 3 which is a block diagram of the various components of the apparatus used in the treatment of slaughtered animals. A computer 100 is run by a program 104. A modem 102 may be connected to the computer for transferring data over a phone line and for remote control of the site computer. The preferred program for remote communications and control is PCNX made by Wendin. Electronic control means 106 is interfaced with the computer and in turn controls the opening and closing of electronic valves 112. "Open" control lines 108 and "closed" control lines 110 are included to operate the normally closed valves 112 (which correspond to valve 62 in Figure 1). Note in Figure 3 that there are four such valves corresponding to four dispensing conduit lines, one such line being identified in Figure 1 at 60. Electronic control means 106 opens the electronic valves 112 by placing a 110 volt potential across selected "open" control lines 108 while holding the "closed" control lines 110 at 0 volts. In order to close the electronic valves, the "closed" control lines 110 are held at 110 volts while the "open" control lines 108 are held at 0 volts. Electronic valves 112 control the flow of solution through the dispensing conduit lines 114 (which correspond to 60 in Figure 1). The solution is contained within the solution handling section 116 already described above with reference to Figures 1 and 2.

Figure 4 shows a block diagram of computer 100 from Figure 3. The block diagram shows a generic microprocessor for computer 100. Any computer may be used. However, a microcomputer is the most economical. Generic microcomputer 100 is made up of a variety of components attached to the system bus 101 as shown. The central processing unit (CPU) 118 runs the entire system. A read only memory (ROM) 124 contains the low level routine, i.e., basic input/output routines. A random access memory (RAM) 126 is used to store the operating systems and the actively running programs, along with data. The clock 128 is used to synchronize all of the operations which take place along system bus 101. A cathode ray tube (CRT) display 122 is connected to the system bus by means of CRT controller 120. A keyboard for operator input and control 134 is connected to the system bus by means of keyboard interface 132. Function keys 136 are used as control keys in the preferred embodiment. A direct memory access controller (DMA) 138 is used to control the movement of data and programs from the magnetic disk storage unit 142 connected to the system bus by interface 140, to RAM unit 126. The DMA 138 controls this operation without using CPU 118, thus freeing up the CPU for more important tasks. Electronic control means 106 is connected with the system bus as well.

Referring to Figure 5, the main menu display of program 104 is shown. The overall program is made up of several subprograms identified herein by Appendices I - VII, I - VI being written in C language while VII is written in assembly language. Appendices VII and IX, X, XI, XII and XIII are included because they are referred to from time to time in various of the appendices I - VII. The main driving portion of the program, is shown in Appendix I (see below). The program shown in Appendix I is the program which calls all the other subprograms. The display of the box form of the menu is controlled by the program shown in Appendix II (see below).

The plant ID code is shown at 150. Header information 152 is also controlled by the program in Appendix II. The actual text of the menu is controlled by the program shown in Appendix III (see below).

If the operator chooses "P" indicated at 154 in Figure 5, for example, control is passed from the program in Appendix I to the program shown in Appendix IV (see below) displaying the menu of Figure 10. If "A" at 156 in Figure 5 is chosen, control is passed from the program in Appendix I to the program shown in Appendix V (see below) displaying the menu of Figure 6. If "F" as at 158 in Figure 5 is selected by the operator, control is passed from the program in Appendix I to the program shown in Appendix VI (see below). It should be understood that the letters "P", "A", and "F" may be replaced by any number of designations, as long as control is passed from a main calling program such as the one shown in Appendix I to a subprogram such as the ones shown in Appendices IV-VII. Keyboard 134 is utilized by the operator to choose the options off the main menu.

Referring now to Figure 6, the operator must identify themselves and enter the proper password to gain access to the menu shown in Figure 7. The password insures that only authorized people may access the functions shown in Figure 7. The menu in Figure 7 is controlled by the program of Appendix III and is displayed when the program contained in Appendix V is called. The operator selects an option by means of keyboard 134. If the operator chooses "P" at 170 in Figure 7, these passwords can be changed or modified. There are three types of passwords: the administrative password, daily passwords and operator passwords. When "P" is chosen, the menu shown in Figure 8 is displayed. If the operator chooses "S" shown at 172 in Figure 7, then the menu shown in Figure 9 is displayed. When the operator chooses "O" shown at 171 in Figure 6, the authorized operators may be changed. If the operator chooses "C" shown at 176 in Figure 7, the accounting files which contain information about the animals being

processed are copied to a floppy diskette. If the operator chooses "E" shown at 178 in Figure 7, control passes from the program of Appendix I back to the disk operating system.

Referring now to Figure 8, the change password menu is displayed. The administrative password is shown at 180, the daily password is shown at 182 and the operator passwords are shown at 184. The dates at 184 show when the operator passwords expire. If all the operator passwords have expired and the operator needs to utilize the equipment, he can use the daily password 182 which is operable only for the day which it is set.

Referring now to Figure 9, the "S" option "Change System Information" of Figure 7 causes this menu to be displayed. The plant ID can be changed at 150. The program refers to the flow rate shown at 190 to perform its accounting calculations. If the flow rate of the solution handling section changes, the program can be informed by making a correction at 190. The number of valves (112 in Fig. 3) controlled by the program can be changed at 192. In the preferred embodiment this number can range from 1 to 4 although a greater number of valves may be controlled by the same program with minor modifications. The time it takes for a valve to open or close is shown at 194. The time is shown in units with one unit equal to 1/18th of a second. Lastly, the base address can be changed at 198, the base address controls where the computer addresses the circuit shown in Figure 18.

Referring now to Figure 5, when the operator chooses "F", a variety of accounting reports may be printed to an output device, either to the CRT or to a printer in the preferred embodiment.

Referring now to Figure 10, the operators must indentify themselves and enter a password to obtain access to the menu shown in Figure 11. The menu shown in Figure 12 is displayed in response to the selection of the "P" option in Figure 11. If the number of valves is set to 4 in Figure 9, then all four displays will be shown simultaneously. The operator selects a valve to operate by means of function keys 136 shown in Figure 4. Function key F1 controls valve 1, function key F2 controls valve 2 and so on. It is to be understood that any variety of key control can be utilized in this context. Once the operator has chosen a valve to control, the border of the menu is highlighted to show the operator which screen to refer to and which valve is being controlled.

If the "R" option is chosen from Figure 11, then all valves are opened for a period of time to clean the apparatus.

Referring now to Figure 13, an information input flow chart is shown by means of which an operator inputs data to the program for operation of the apparatus. The program for the following flow chart is contained in Appendix IV. The operator selects a valve in block 250, where N represents the valve number the operator has selected. The input screen is then highlighted in block 252. The operator then selects an animal type in block 244 by picking out one of the display choices in window 208 of Figure 12. The operator then selects the animal subtype in block 256 by means of window 210 of Figure 12. If the weight displayed for animal type and subtype is in correspondence with the type of animal to be treated, then the operator can open the appropriate valve by means of option "S" at 222 from the menu of Figure 12. However, if the operator wishes to change the weight shown, he may do so with option "W" shown at 220 in Figure 12. The operator inputs the weight in block 260 of Figure 13, and in block 262 of Figure 13 the weight is checked against a range of values which varies with each animal type to determine if it is within the allowable range. If the weight is within the allowable range, control is passed to block 264 of Figure 13. However, if the weight is not within allowable range, the operator must rekey the weight. Whenever the operator is ready, he may select the "S" option "start" shown in Figure 12 at 222 and as indicated in block 264 of Figure 13. At block 266 of Figure 13 an integer value which corresponds to the length of time the valve is to be be open is located and selected in the memory and loaded into an address "N segment" (N=1, 2, 3, etc) of the ET elapsed time counter which is shown in Figure 14. There are three counters for each valve: denoted OT, CT and ET, respectively as shown in Figure 14.

Referring now specifically to Figure 14, a diagram or memory map of these valve counters is shown. There are three memory locations set aside in the three counters associated with each valve. Valve 1 where N = 1 is shown at 274. The other three valves operate the same way as valve 1. The three counters are the open transition counter (OT) shown at 268, the closed transition counter (CT) shown at 270, and the elapsed time counter (ET) shown at 272. The ET counter is initialized to O, while the OT and CT counters are initialized to the valve shown at 194 in Figure 9.

Referring now to Figure 15, a diagram or memory map of the flags utilized by the program is shown. The "open transition flag" (OTF) shown at 276 is set to TRUE whenever the valve with which it is associated is in the process of being opened. The "open valve flag" (OVF) shown at 278 is set to TRUE whenever the valve is opened. The "closed transition flag" (CTF) shown at 280 is set to TRUE whenever the valve is in the process of being closed. The closed valve flag (CVF) shown at 282 is set to TRUE whenever the valve is closed.

These flags inform the program whether the valve is in the process of being opened or closed, which in the preferred embodiment is shown at 194 in Figure 8. However, a variety of elapsed times for opening and closing may be used. The purpose of the transition flags is to prevent commands from being sent to a valve while the valve is in the process of being opened or closed.

Referring now to Figure 16, an interrupt program flow chart is shown. A "hardware interrupt" is generated by the computer 18.2 times per second. The assembly language program shown in Appendix VII is the interrupt program which corresponds to Figure 16. This program is called and executed 18.2 times per second by the computer. Figure 16 shows one interrupt cycle of this program. The program checks the status of all four valves before it returns control to the main program. At 290 a counter N, which corresponds to each valve is set to 0. A counter, used to increment N, is shown at 294. A conditional branch is shown at block 296. If the elapsed time counter of address N segment, where N can be 1-4, is greater than 0, then the program will move to test for the various cases shown at 298-304. However, if ET is equal to 0, the interrupt program perceives that valve N is closed and the computer loops back to the counter at 294. If the elapsed time (ET) counter is greater than 0, the various flags shown in Figure 12 are checked. Case 1, shown at 298, represents the situation in which the OTF flag is set to FALSE and the OVF flag is also set to FALSE. In this case, the valve must be opened by the computer. The program sets the select N line (shown in Figure 18) to a high voltage potential "high," which will start the process of opening the valve in block 306 of Figure 16. The program then sets the OT counter to the value shown at 194 in Figure 9 in block 308. 144 is equivalent to 8 seconds and may be varied depending on the length of time required to open or close a valve). The program then sets the OTF flag to TRUE in block 310 of Figure 16 to inform the program that the valve is now in the transition phase of opening.

Control is then passed back to point 1 shown at 292 in Figure 16 to increment the counter and check the next valve. Case 2 is shown at 300 with the OTF flag being set to TRUE and the OVF flag being set to FALSE. In this case the valve is in the process of being opened. The program will execute 144 times before the valve is finished opening. The OT counter is decremented by one integer value in block 312 of Figure 16. In block 314 of the Figure a conditional branch is shown where, if the OT counter equals 0, the program sets the OTF flag to FALSE in block 316, signifying that the valve is no longer in the transitional phase. The OVF flag is then set to TRUE in block 318, signifying that the valve is now open. If the OT counter is not equal to 0 in conditional branch 314, then the program perceives that the valve is still in the process of being opened. At this point control is then passed back to 292 in Figure 16 where the counter is incremented and checks the next valve.

Case 3 is shown at 302 in which where the OTF flag is set to FALSE, the OVF flag is TRUE and the pause flag (PF) is FALSE. In this case the valve is open. The valve is kept open for a time which is the substantial equivalent to the integer value stored in the ET counter. The program checks to determine whether the ET counter is equal to 1 in conditional branch 320 of Figure 13. If it is not equal to 1, then the ET counter is decremented in block 322 and control passes to point 292. However, if the ET counter is equal to 1, the program realizes it must initiate the "close valve process." Therefore, it decrements the ET counter to 0 in block 324, sets the select N line to "low" which initiates the "close valve signal" in block 326, sets the CTF flag to TRUE in block 328 (which informs the program that the valve is in the closed transition phase), and sets the CT counter to the value shown at 194 in Figure 9 in block 330. Control is then passed to point 1 shown at 292.

Case 4 is shown at 304, with CTF set to TRUE and CVF set to FALSE. In this case the valve is in the "close transition phase". The CT counter is decremented in block 332 of Figure 16, then checked to determine if the CT counter is equal to 0 in conditional branch 334. If it is not equal to 0, control is passed to point 1 at 292. However, if it is equal to 0, the program perceives that the valve is closed and, therefore, sets the CTF flag to FALSE in block 336 and sets the CVF flag to TRUE in block 338. Control is then passed back to point 1 at 292. Complete cycling of N = 14 occurs 18.2 times per second. This corresponds to checking the condition of each valve.

Referring now to Figure 17, the Pause Program Flow Chart is shown. While the valve is open, the operator may wish to halt the flow of solution to take care of some problem. The pause program allows a valve to be closed for a period of time while preventing the ET counter from being decremented, so that upon reopening the valve the previously determined remaining amount of solution may be injected into the animal. By selecting the valve to control by means of the function keys F1 through F4 in the preferred embodiment, the operator can gain access to the input screen of Figure 12 which controls the particular valve in question shown at block 340 in Figure 17. The operator then selects the "P" option from the menu shown in Figure 12, also shown in block 342 of Figure 17. In blocks 344 through block 348 of Figure 17, the program checks to determine if the

valve is paused, being closed or in a closed state. If any one of these conditions exists, the pause program ends. A closed valve may not be paused, and a valve that is paused, closed, or in a closed transition phase may not be paused. If the valve is open or opening, control passes to block 349 whom the pause flag is set to true. Then control then passes to block 350 in which the select N line is set "low" which causes the valve to close at block 352. The elapsed time counter is then prevented from being decremented at block 354. The valve remains closed until the operator selects "resume" from the menu in Figure 12, controlled by conditional branch 356. Once "resume" is selected, the program determines whether the pause flag, shown at 283 in Figure 15, has been set to TRUE by means of conditional branch 358. If the pause flag has not been set to TRUE, then the "resume" is ignored and the program ends. If the pause flag is TRUE then the pause flag is set to FALSE and the valve begins to open, controlled by blocks 360 and 362. The elapsed time counter begins to decrement again at block 364.

A modification of the pause program shown in Figure 17 may be used to "pause" all open valves simultaneously and "resume" all paused valves with these two functions being assigned special function keys.

Referring now to Figure 18, a circuit diagram of electronic control means 106 of Fig. 3 is shown. The purpose of this circuit is to provide four sets of on/off lines. One set for each valve. Many circuit arrangements may be substituted for the one disclosed. Address lines A0-A9 shown at 370 are split, A3-A9 going to buffer 372, and A0-A2 going to buffer 373.

Address lines A0-A9 are checked by comparator 392 against the preset dip switches 390. If the address is valid and the CPU is in a low state (IOW at 378 is low), then the JK flip flops 388 are enabled.

A0-A2 are decoded at 381 resulting in eight lines or four sets of on/off control lines. The eight control lines shown at 382 are buffered at 384 and 386 before being passed to the JK flip flops. Ultimately the four select lines shown at 390 are produced. If for example select 1 goes high, the ON 1 line (also 108 in Fig. 3) is held at zero volts and the "OFF 1 line" (also 110 in Fig. 3) is held at 110 volts (shown generally at 392) thereby closing the valve controlled by the select 1 line. If select 1 goes low the opposite takes place and the valve is opened.

Additional embodiments of the invention will occur to others. The scope of the invention is to be limited only by the appended claims. Accordingly, reference should be had to the following claims in determining the scope of the invention.

Claims

1. Apparatus for injecting treatment solution into a plurality of slaughtered animals, the apparatus comprising:

   solution handling means including a plurality of electrically operated valves, each valve being constructed and arranged for controlling the flow of solution to an individual animal;

   control means operably connected to the valves for opening and closing the valves;

   programmed means operably connected to the control means, the programmed means comprising:

   computer means including data entry means for entering data and a program;

   means responsive to data received by the data entry means for selecting a duration of time;

   means responsive to operator input for interacting with the control means to operate a valve for a length of time corresponding to the selected duration of time to control the flow of solution into an animal.

2. The apparatus of claim 1 wherein said entering data comprise data concerning at least the type and weight of animal and the program comprises operating instructions for the computer means and stored data representative of various durations of time associated with at least a variety of animals' types and weights.

3. The apparatus of claim 2 including counter means for receiving the selected duration of time, said means responsive to operator input being responsive to the counter means.

4. The apparatus of any of the preceding claims wherein said computer means comprises micro computer means including a keyboard for entering the input data.

5. The apparatus of any of the preceding claims including means for generating accounting records relating to the type of animal process and the amount of solution use.

6. The apparatus of claim 5 wherein the accounting records further comprise a daily account record and a cumulative account record.

7. The apparatus of claim 5 or claim 6 including a modem, and means responsive to the modem for the remote control of the apparatus and the transfer of account information to the remote control side.

8. The apparatus of any of the preceding claims further including passoword protection such that only an authorized operator may input data.

9. The apparatus of any of claims 4 to 8 including means responsive to the Keyboard for interrupting the flow of solution into an animal further including means responsive to the Keyboard for re-establishing the flow of solution for the remainder of the duration of time.

10. A method of controlling the injection of predetermined amounts of solution into slaughtered animals by means of a microcomputer and apparatus including a plurality of valves for controlling the flow of solution into individual animals comprising the steps of:

predetermining durations of time to operate a valve, the times relating to the amount of solution to inject into an animal and varying depending on the type and weight of the animal;

storing the predetermined durations of time in a memory of a microcomputer;

selecting a valve to operate whereby the flow of a solution is controlled;

entering data into the microcomputer relating to the animal type and weight;

selecting a duration of time from the stored durations, based on the data entered;

operating the selected valve for the selected duration of time;

whereby a predetermined amount of solution is injected into the slaughtered animal.

11. The method of claim 10 further comprising the step of:

storing accounting data relating to the type of animal processed and amount of solution used.

12. The method of claim 11 further comprising the steps of:

stopping the flow of solution at an operator's command, restablishing the flow of solution at an operator's command, such that solution will flow for the remainder of the duration time.

13. The method of any of claims 10 to 12 wherein said microcomputer includes a keyboard, a CPU, a RAM, a ROM, and is interfaces with a control means which is operably connected to said plurality of valves.

Fig. 1

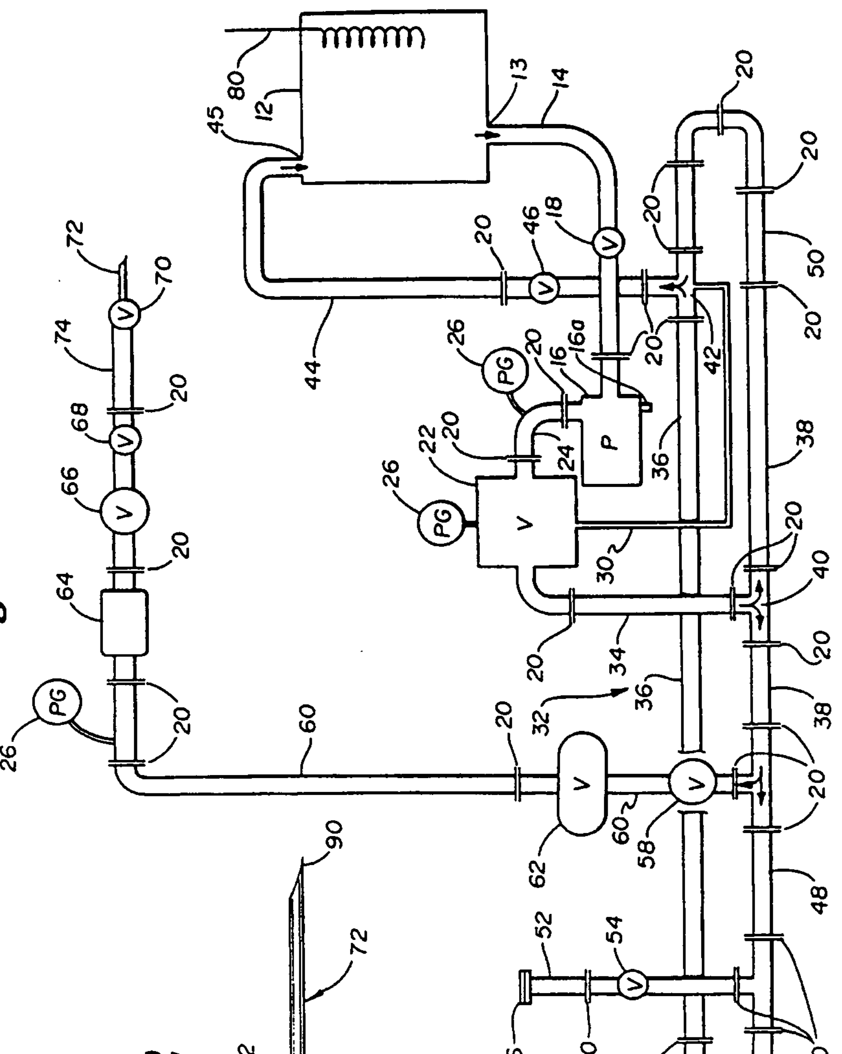

12
13
14
16
16a
18
20
22
24
26
30
32
34
36
38
40
42
44
45
46
48
50
52
54
56
58
60
62
64
66
68
70
72
74
80
V
P
PG

Fig. 2

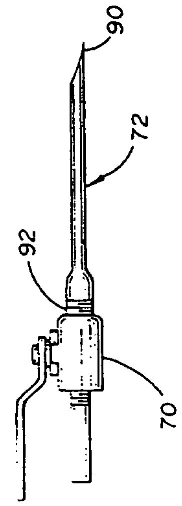

70
72
90
92

Fig. 3

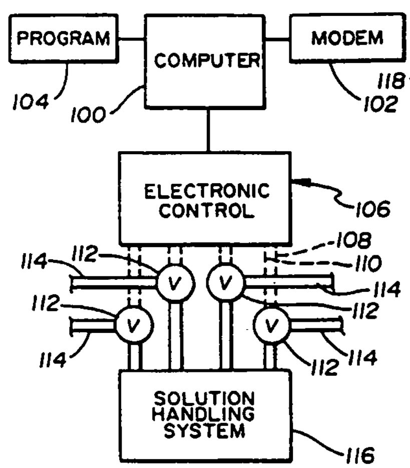


Fig. 4

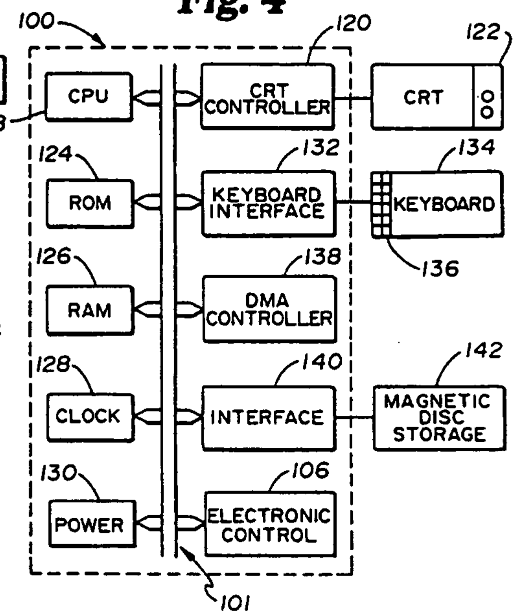


Fig. 5

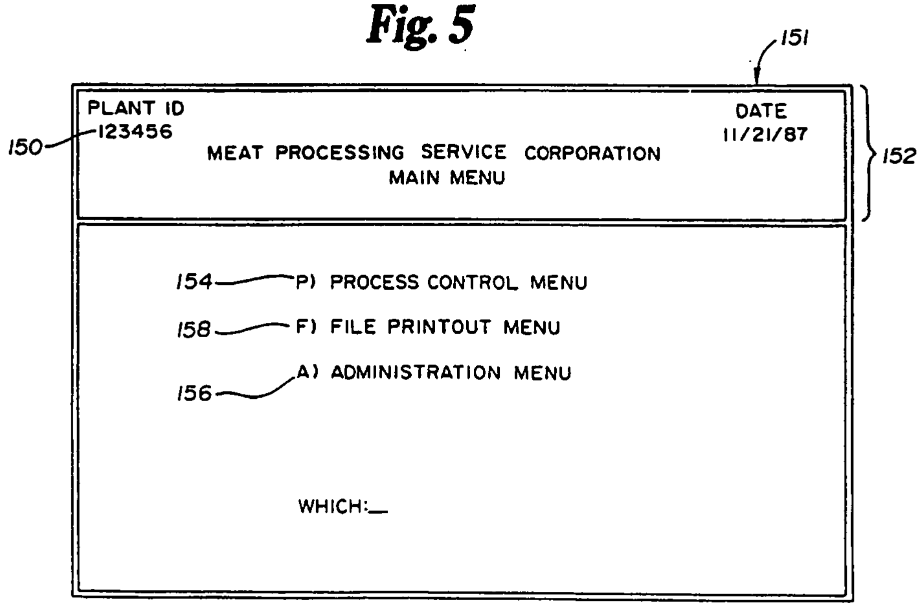


Fig. 6

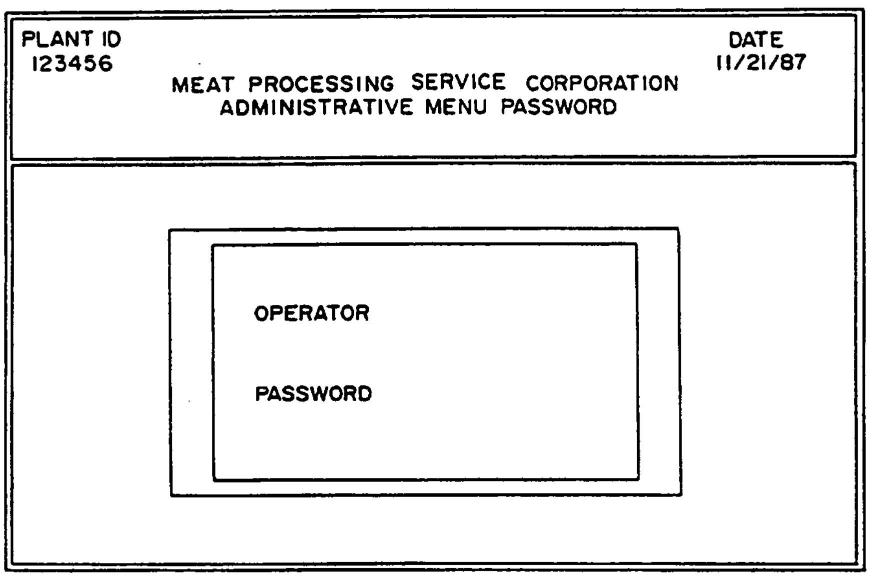

PLANT ID
123456
DATE
11/21/87
MEAT PROCESSING SERVICE CORPORATION
ADMINISTRATIVE MENU PASSWORD
OPERATOR
PASSWORD

Fig. 7

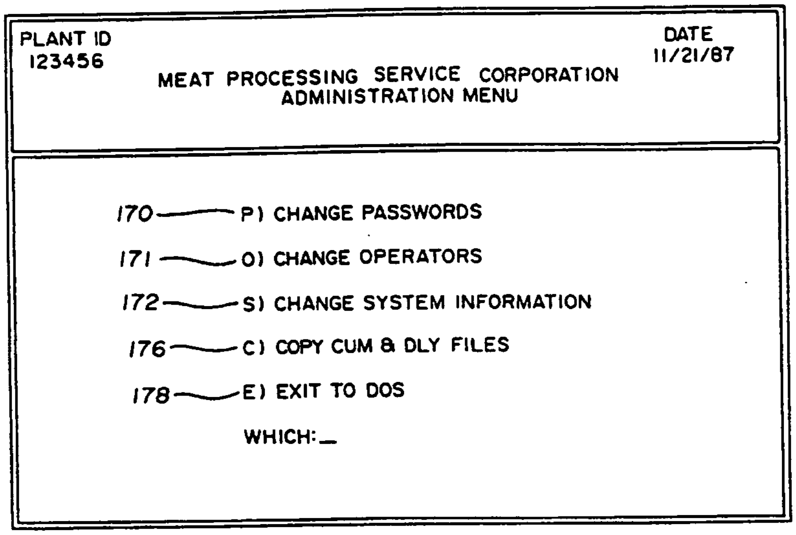

PLANT ID
123456
DATE
11/21/87
MEAT PROCESSING SERVICE CORPORATION
ADMINISTRATION MENU
170
P) CHANGE PASSWORDS
171
O) CHANGE OPERATORS
172
S) CHANGE SYSTEM INFORMATION
176
C) COPY CUM & DLY FILES
178
E) EXIT TO DOS
WHICH:_

Fig. 8

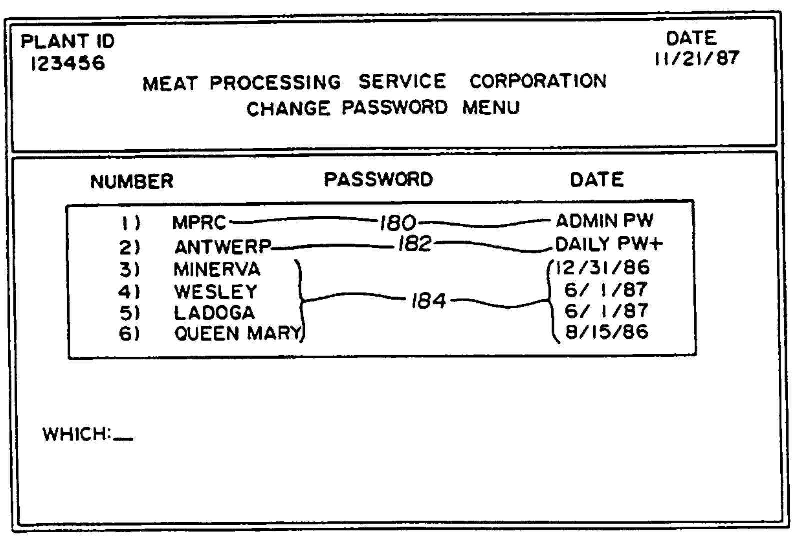

PLANT ID
123456
DATE
11/21/87
MEAT PROCESSING SERVICE CORPORATION
CHANGE PASSWORD MENU
NUMBER
PASSWORD
DATE
1) MPRC
180
ADMIN PW
2) ANTWERP
182
DAILY PW+
3) MINERVA
4) WESLEY
5) LADOGA
6) QUEEN MARY
184
12/31/86
6/ 1/87
6/ 1/87
8/15/86
WHICH:_

Fig. 9

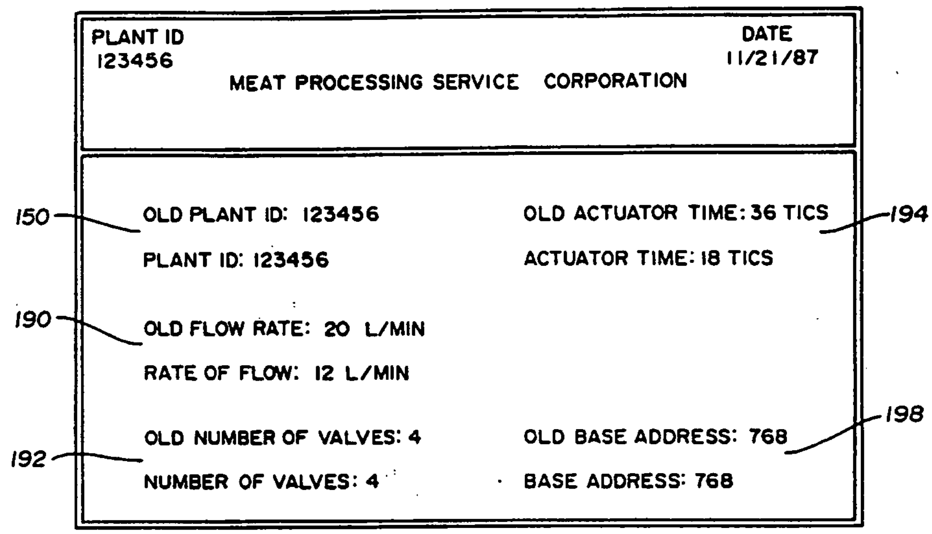

PLANT ID
123456
DATE
11/21/87
MEAT PROCESSING SERVICE CORPORATION
150
OLD PLANT ID: 123456
OLD ACTUATOR TIME: 36 TICS
194
PLANT ID: 123456
ACTUATOR TIME: 18 TICS
190
OLD FLOW RATE: 20 L/MIN
RATE OF FLOW: 12 L/MIN
198
OLD NUMBER OF VALVES: 4
OLD BASE ADDRESS: 768
192
NUMBER OF VALVES: 4
BASE ADDRESS: 768

Fig. 12

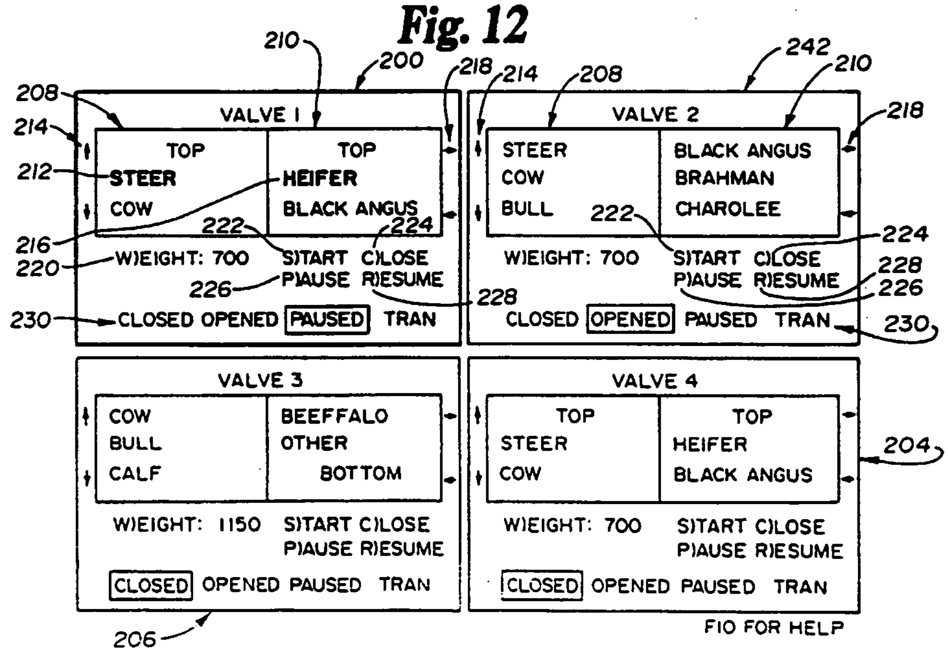

VALVE 1
TOP
TOP
STEER
HEIFER
COW
BLACK ANGUS
W)EIGHT: 700
S)TART C)LOSE
P)AUSE R)ESUME
CLOSED OPENED PAUSED TRAN
VALVE 2
STEER
BLACK ANGUS
COW
BRAHMAN
BULL
CHAROLEE
W)EIGHT: 700
S)TART C)LOSE
P)AUSE R)ESUME
CLOSED OPENED PAUSED TRAN
VALVE 3
COW
BEEFFALO
BULL
OTHER
CALF
BOTTOM
W)EIGHT: 1150
S)TART C)LOSE
P)AUSE R)ESUME
CLOSED OPENED PAUSED TRAN
VALVE 4
TOP
TOP
STEER
HEIFER
COW
BLACK ANGUS
W)EIGHT: 700
S)TART C)LOSE
P)AUSE R)ESUME
CLOSED OPENED PAUSED TRAN
F10 FOR HELP
200
208
210
212
214
216
218
220
222
224
226
228
230
242
204
206

Fig. 10

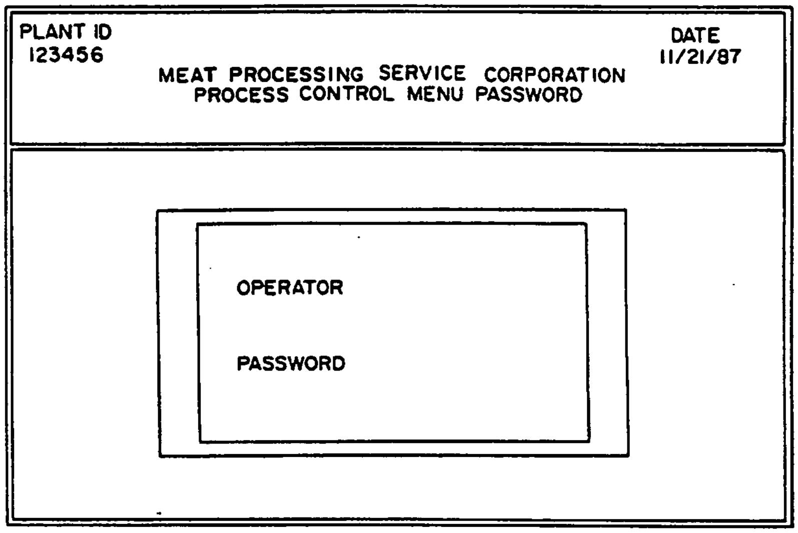

PLANT ID
123456
DATE
11/21/87
MEAT PROCESSING SERVICE CORPORATION
PROCESS CONTROL MENU PASSWORD
OPERATOR
PASSWORD

Fig. 11

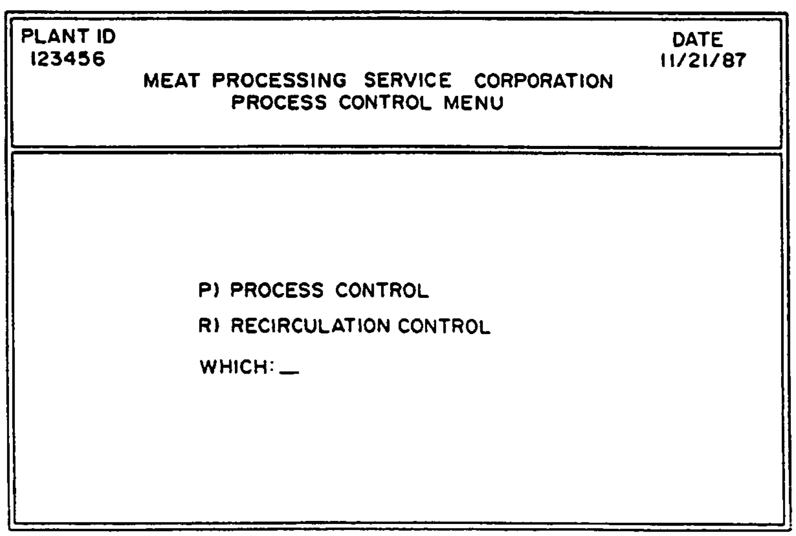

PLANT ID
123456
DATE
11/21/87
MEAT PROCESSING SERVICE CORPORATION
PROCESS CONTROL MENU
P) PROCESS CONTROL
R) RECIRCULATION CONTROL
WHICH: _

Fig. 13

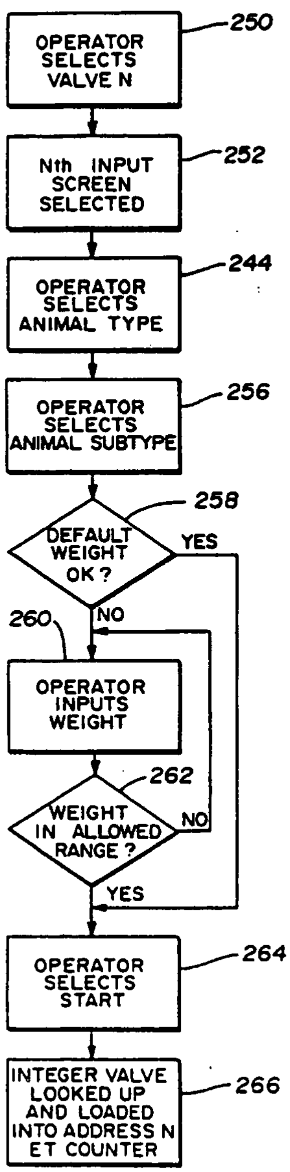


Fig. 14

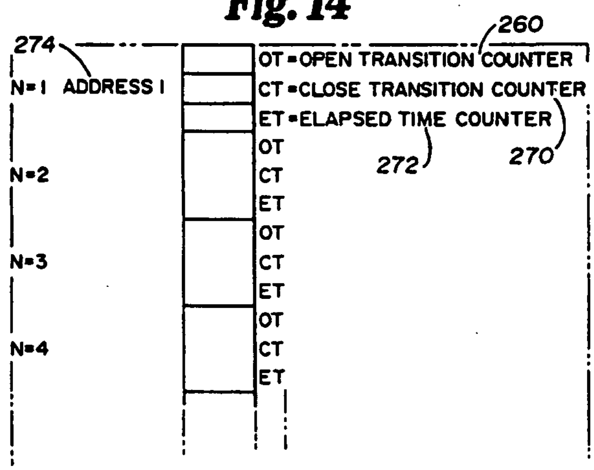
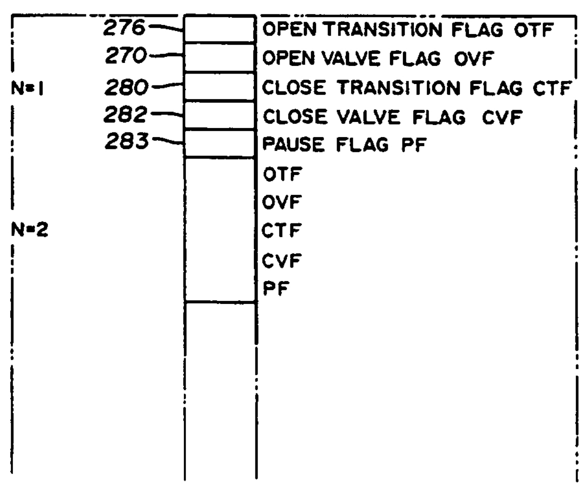


Fig. 15



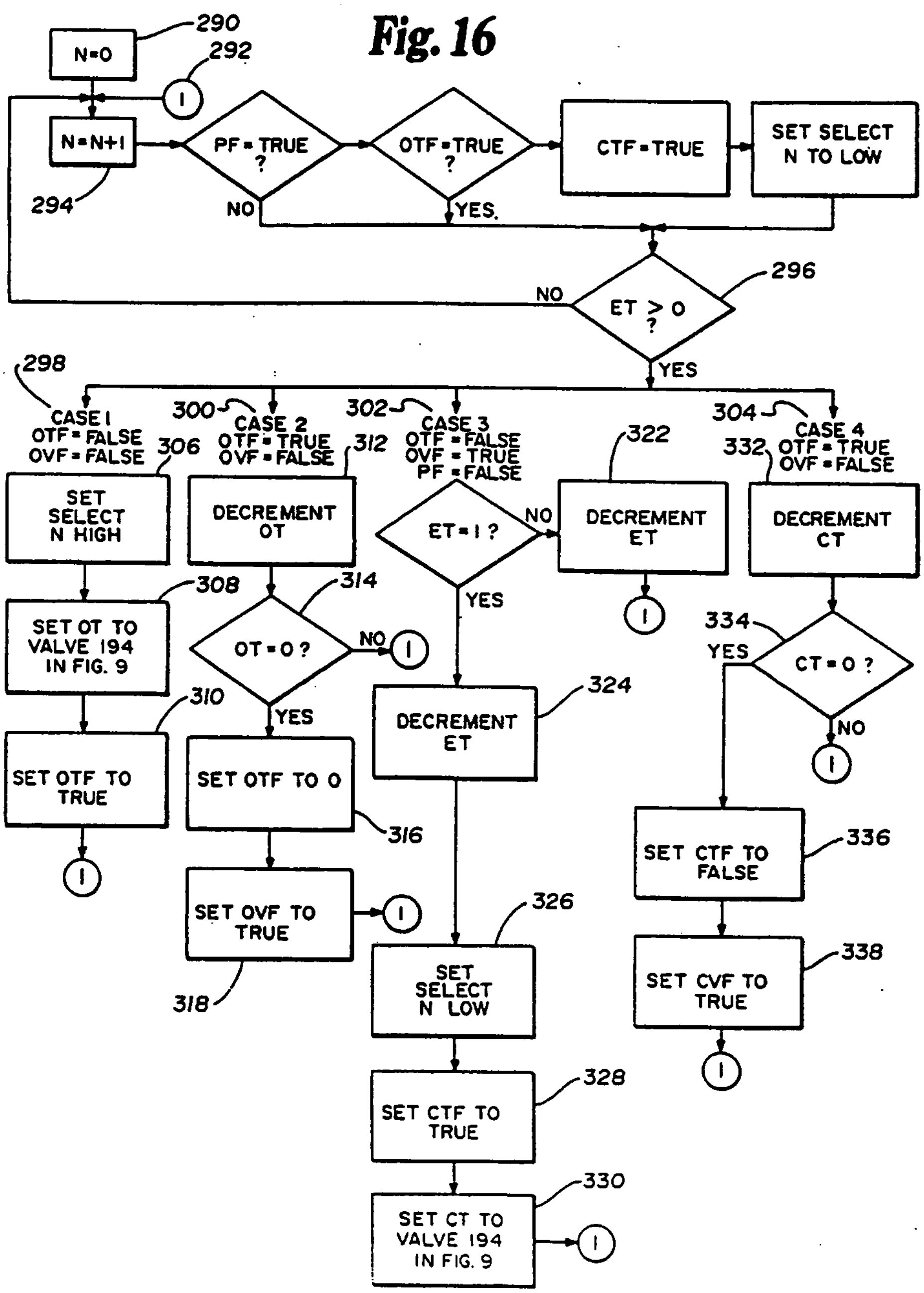
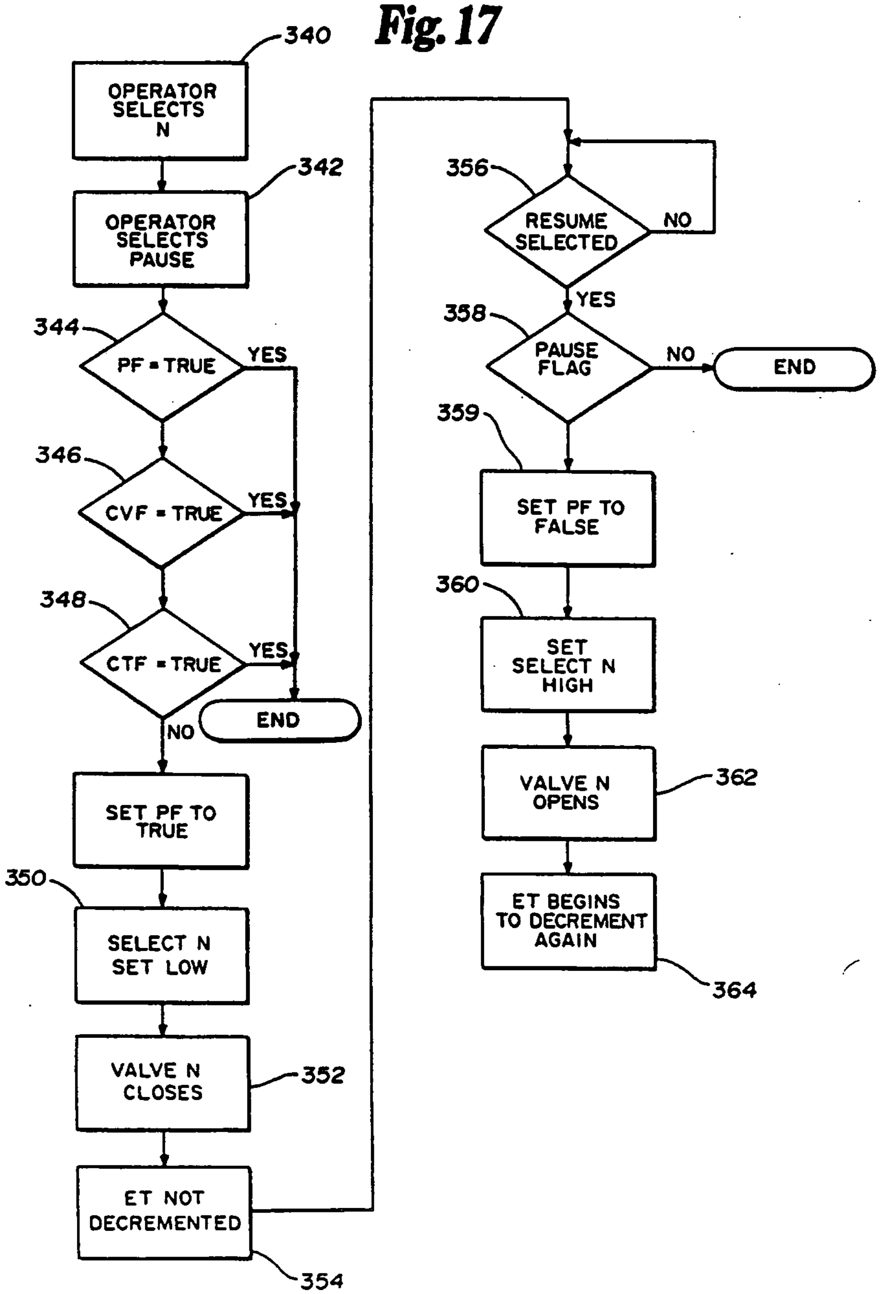

290
292
N=0
N=N+1
294
PF = TRUE ?
NO
OTF = TRUE ?
YES
CTF = TRUE
SET SELECT N TO LOW
296
ET > 0 ?
NO
YES
298
CASE 1 OTF = FALSE OVF = FALSE
300
CASE 2 OTF = TRUE OVF = FALSE
302
CASE 3 OTF = FALSE OVF = TRUE PF = FALSE
304
CASE 4 OTF = TRUE OVF = FALSE
306
SET SELECT N HIGH
308
SET OT TO VALVE 194 IN FIG. 9
310
SET OTF TO TRUE
312
DECREMENT OT
314
OT = 0 ?
NO
YES
SET OTF TO 0
316
SET OVF TO TRUE
318
ET = 1 ?
NO
YES
322
DECREMENT ET
324
DECREMENT ET
326
SET SELECT N LOW
328
SET CTF TO TRUE
330
SET CT TO VALVE 194 IN FIG. 9
332
DECREMENT CT
334
CT = 0 ?
YES
NO
336
SET CTF TO FALSE
338
SET CVF TO TRUE

Fig. 16

Fig. 17



340
OPERATOR SELECTS N
342
OPERATOR SELECTS PAUSE
344
PF = TRUE
YES
346
CVF = TRUE
YES
348
CTF = TRUE
YES
NO
END
SET PF TO TRUE
350
SELECT N SET LOW
VALVE N CLOSES
352
ET NOT DECREMENTED
354
356
RESUME SELECTED
NO
YES
358
PAUSE FLAG
NO
END
359
SET PF TO FALSE
360
SET SELECT N HIGH
VALVE N OPENS
362
ET BEGINS TO DECREMENT AGAIN
364

Fig. 18

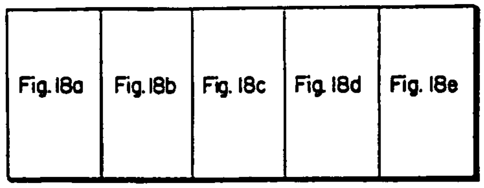


Fig. 18a

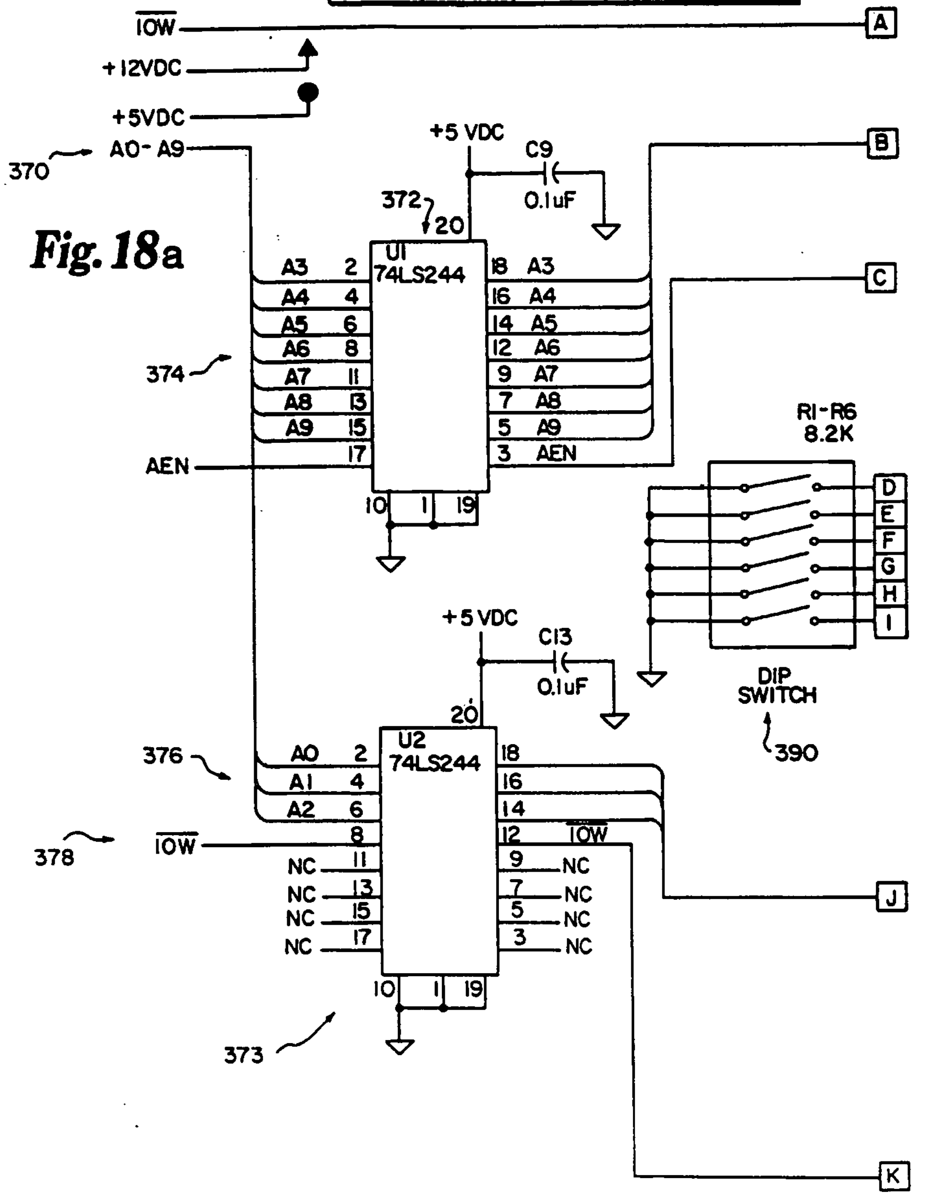


Fig. 18b

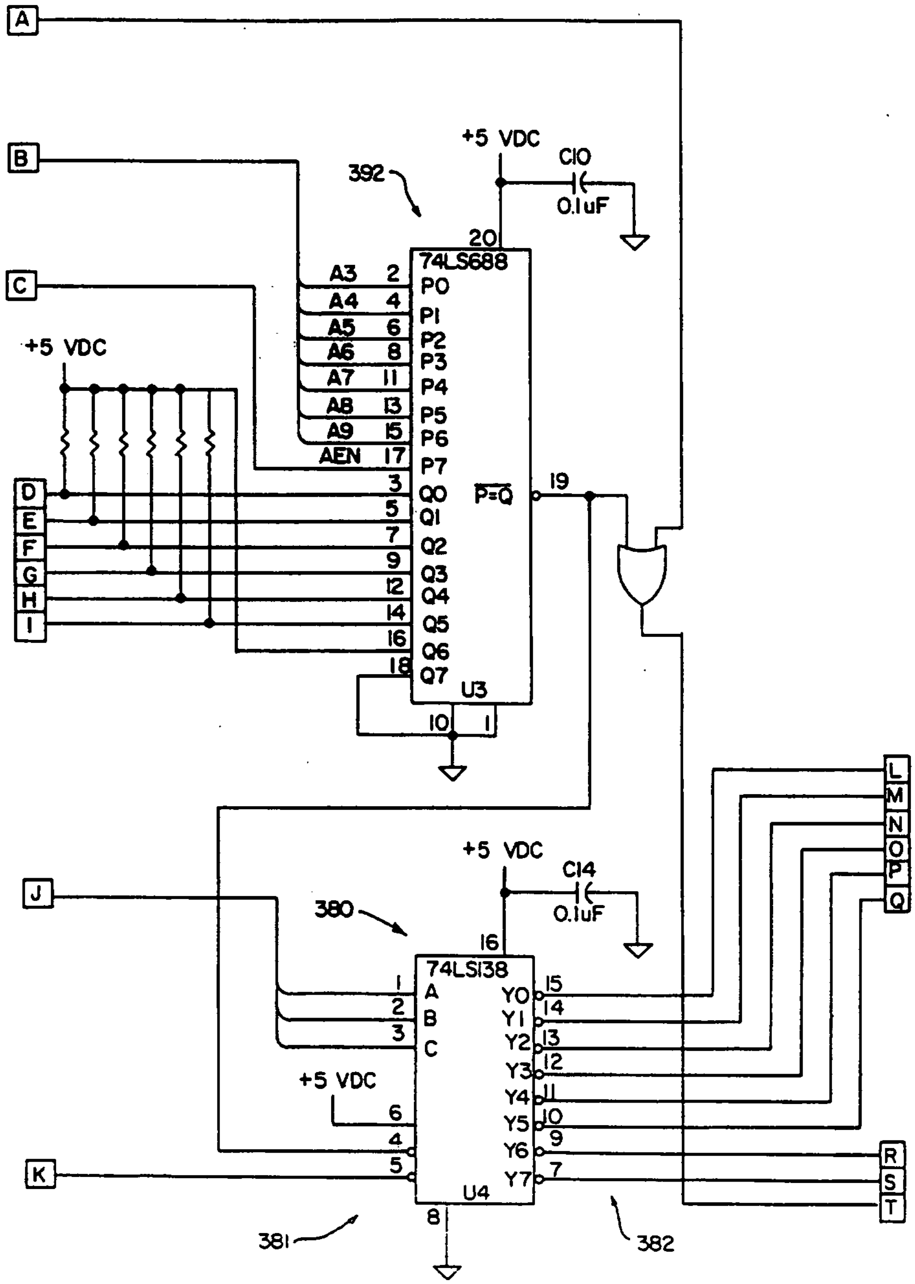

A
B
C
+5 VDC
C10
0.1uF
392
20
74LS688
A3 2 P0
A4 4 P1
A5 6 P2
A6 8 P3
A7 11 P4
A8 13 P5
A9 15 P6
AEN 17 P7
+5 VDC
D
E
F
G
H
I
3 Q0
5 Q1
7 Q2
9 Q3
12 Q4
14 Q5
16 Q6
18 Q7
P=Q
19
U3
10
1
J
+5 VDC
C14
0.1uF
380
16
74LS138
1 A
2 B
3 C
+5 VDC
6
4
5
K
Y0 15
Y1 14
Y2 13
Y3 12
Y4 11
Y5 10
Y6 9
Y7 7
U4
8
381
382
L
M
N
O
P
Q
R
S
T

Fig. 18c

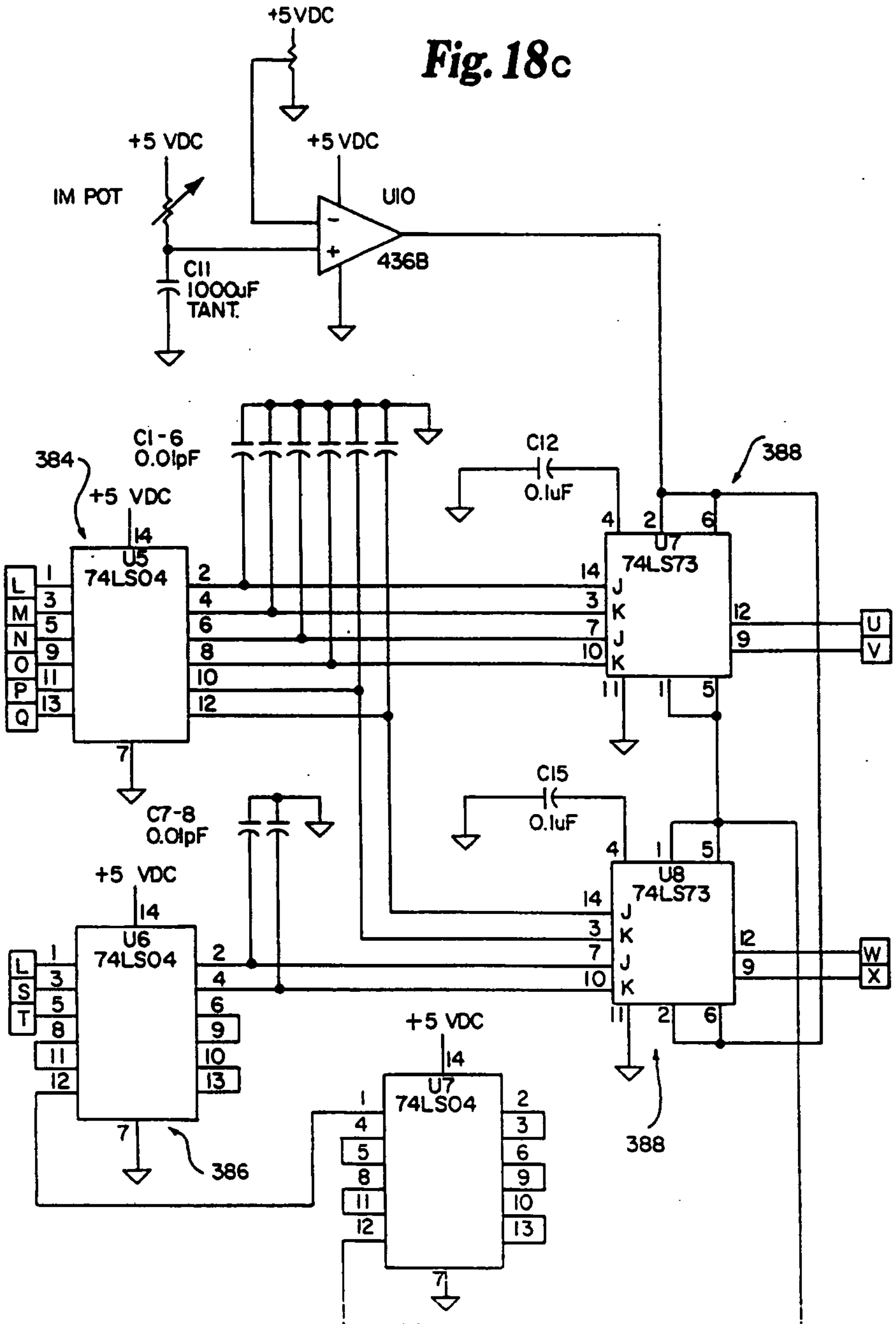

+5VDC
+5 VDC
IM POT
+5 VDC
U10
436B
C11
1000uF
TANT.
C1-6
0.01pF
384
+5 VDC
U5
74LS04
C12
0.1uF
388
U7
74LS73
L
M
N
O
P
Q
U
V
C15
0.1uF
C7-8
0.01pF
+5 VDC
U6
74LS04
U8
74LS73
L
S
T
W
X
+5 VDC
U7
74LS04
386
388

Fig. 18d

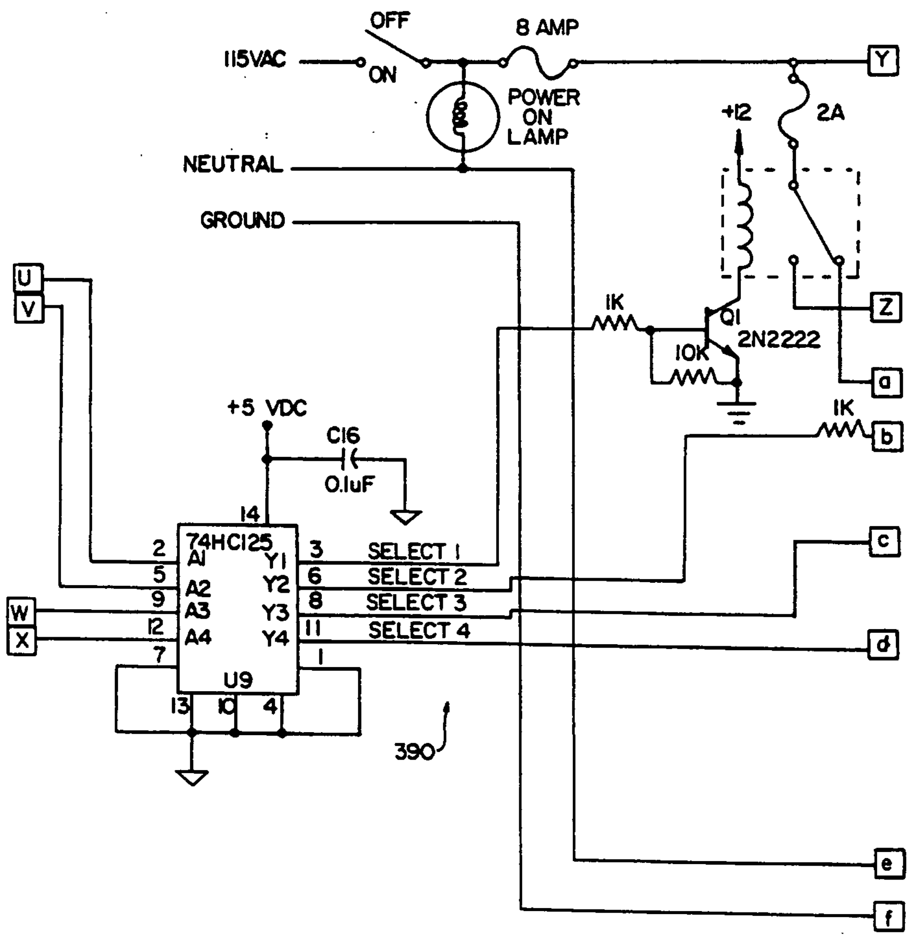
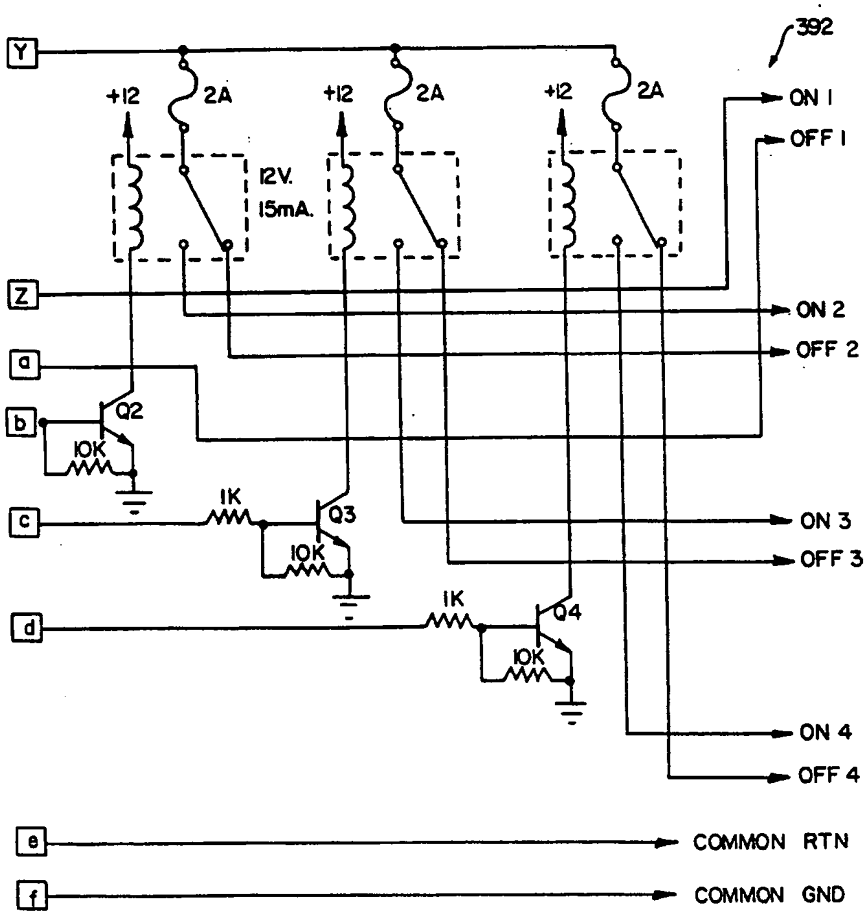

115VAC
OFF
ON
8 AMP
POWER ON LAMP
NEUTRAL
GROUND
Y
+12
2A
Z
a
1K
Q1
2N2222
10K
1K
b
+5 VDC
C16
0.1uF
14
74HC125
U
V
W
X
2
5
9
12
7
A1
A2
A3
A4
Y1
Y2
Y3
Y4
3
6
8
11
1
SELECT 1
SELECT 2
SELECT 3
SELECT 4
c
d
U9
13
10
4
390
e
f

Fig. 18e


392
Y
+12
2A
+12
2A
+12
2A
12V.
15mA.
ON 1
OFF 1
Z
ON 2
OFF 2
a
b
Q2
10K
c
1K
Q3
10K
ON 3
OFF 3
d
1K
Q4
10K
ON 4
OFF 4
e
COMMON RTN
f
COMMON GND